Whether patients with symptomatic carotid stenosis of 30% to 60% will benefit from endarterectomy is not yet known as the prospective studies have not been completed. At present, such patients should be randomly assigned to one of these trials or a decision regarding surgical therapy made based on the ischemic event, the medical condition of the patient, and the angiographic appearance of the lesion. For instance, the presence of a 60% symptomatic stenosis with an ulcer seen on angiography might weigh more heavily in favor of surgical treatment since the NASCET study showed that ulcers in association with stenosis increased the risk of ipsilateral stroke and that surgery was highly beneficial for such patients. There is no role for surgical intervention in patients with symptomatic stenosis less than 30% because the ECST study showed that endarterectomy actually worsened the results at three years—3.3% ipsilateral stroke in the surgical treatment group compared with 1.3% without an operation.

Two trials—VA Asymptomatic Trial No. 167 and the Asymptomatic Carotid Atherosclerosis Study—are attempting to address another unresolved issue, asymptomatic carotid stenosis. Although it is tempting to generalize the results of the studies on symptomatic patients with high-grade stenosis to asymptomatic patients with similar lesions, this is not yet warranted. The one published study of asymptomatic patients with carotid stenosis of 50% to 90% (Carotid Artery Surgery Asymptomatic Stenosis—Operation Versus Aspirin) showed no benefit of surgical therapy compared with aspirin therapy in these patients. Serious methodologic flaws in the study suggest that the issue remains in doubt, however. Until further data become available, the treatment of patients with asymptomatic carotid stenosis must be carefully tailored to each patient, with a tendency toward conservative management unless the stenosis is severe.

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The Limits of Treatment of Malignant Gliomas

THE DIAGNOSIS OF MALIGNANT GLIOMA—anaplastic astrocytoma and glioblastoma multiforme—has traditionally been associated with a sense of hopelessness for health care professionals as well as patients. Physicians have been taught that the prognosis is uniformly poor regardless of the treatment. This has led to a conservative approach for many patients with malignant glioma, with survival ranging from 12 to 38 weeks.

Recent experimental treatments have failed to extend survival for patients with malignant gliomas. Despite a lack of effective new treatment options, subgroups of patients are "long-term" survivors with standard multimodality therapy. The current clinical challenge is twofold: the selection of patients who are good candidates for multimodality therapy, and the maintenance of quality, not quantity, of life for these patients.

Many factors influence the prognosis of malignant gliomas. Age is probably one of the strongest predictors of survival, as patients aged 18 to 44 years have a median survival of 107 weeks, whereas patients older than 65 have a median survival of 23 weeks. Neurologic function at the time of diagnosis, a history of a previous low-grade tumor, and the histologic composition of the tumor also affect the prognosis substantially. The treatments that influence survival are radiation therapy, surgical therapy, and chemotherapy.

Patients who undergo a complete resection of the tumor, as seen on computed tomography (CT) or magnetic resonance imaging (MRI) scans, have a median survival of 70 weeks, in contrast to a median survival of 19 weeks in patients who undergo only biopsy of the tumor. Magnetic resonance imaging and CT scans do not identify the outermost border of malignant brain tumors; areas that appear "normal" on these imaging studies have been shown to contain tumor cells. Surgical therapy is therefore not curative for high-grade gliomas. An improved ability to identify tumors intraoperatively and map eloquent cortical functions, such as language and motor areas, allows safe surgical resection and cytoreduction in an increasing number of previously "inoperable" patients. Despite no evidence of tumor on postoperative imaging studies, almost all patients have recurrences; 80% of these recurrences will be within 2 cm of the resection margin.

Radiation therapy is still the most effective treatment for these tumors. Regional irradiation in the range of 60 Gy (3 cm beyond the tumor border seen on CT or MRI) is given at most institutions. To preempt recurrences at surgical margins, some centers have recently begun protocols using radioactive seeds (brachytherapy) or stereotactic radiosurgery to boost the tumor margins with single doses as high as 20 to 30 Gy. Most studies using chemotherapy have shown only minimal benefit. Individual patients can respond dramatically to chemotherapy, however, with imaging resolution of the tumor and improved neurologic function. A third of patients will have some response to chemotherapy. In young patients, particularly those with anaplastic astrocytoma, adjuvant chemotherapy with procarbazine hydrochloride, lomustine, and vincristine sulfate has proved beneficial and is extremely well tolerated.

In patients younger than 65 who still enjoy good function, maximum surgical resection, followed by radiation therapy, with a boost to the resection margin, and a trial of adjuvant chemotherapy is currently the most likely approach to maintain quality of life and extend survival. It is essential to observe this group of patients closely with imaging studies repeated every two to three months. Single photon-emission CT scans using thallous chloride Tl 201 are extremely effective in detecting tumor recurrences and in distinguishing recurrence from radiation necrosis. To maintain function and quality of life, it is important to intervene early when tumor recurrence is the likely diagnosis. A second surgical resection or stereotactic radiosurgery can sometimes be effective. Stopping or changing chemotherapy should also be considered. Patients for whom these treatments fail should be considered for experimental approaches, again with the caveat that quality, not quantity, of life should be the goal of treatment.

Strategic planning of an aggressive multimodality treatment approach is best achieved through the collaboration of a "brain tumor team" that includes neurosurgeons, radiation oncologists, medical oncologists, and other health care professionals. This ensures that the patient receives the maximum benefit available from the multidisciplinary treatment of malignant gliomas.

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Indications and Limitations of Stereotactic Radiosurgery

STEREOTACTIC RADIOSURGERY is an important new treatment option for many patients with brain lesions. Although radiosurgical procedures have been used in a limited way for more than 20 years, the development of computerized imaging—computed tomography and magnetic resonance imaging—has created many new applications. By coupling stereotactic localization techniques with a sharply collimated beam, specialized instrumentation makes it possible to target precisely an ablative dose of ionizing radiation to a well-circumscribed brain lesion. With an accuracy approaching 1 mm, a large "necrosing" dose of radiation (10 to 50 Gy) is delivered at one time. Radiosurgical treatment often supplants a craniotomy and is typically done on an outpatient basis. The three basic types of radiosurgical technique are distinguished by radiation source: heavy charged particle; gamma knife, which uses 201 cobalt 60 sources; and linear accelerator-based systems. Radiophysical and clinical studies suggest that under most circumstances the three techniques are comparable.

Radiosurgery has proved to be a valuable tool for treating many benign lesions. For arteriovenous malformations, a single treatment produces intimal hypertrophy and gradual angiographic obliteration over one to two years in 85% to 90% of patients. This result affords permanent protection against rebleeding. During the latent period, however, the risk of rehemorrhage is unaffected. The major complication of radiosurgical treatment of arteriovenous malformations is delayed radionecrosis. The reported risk of this problem ranges from 3% to 9% and is proportional to the volume being irradiated. Smaller but equally effective doses of radiation are currently being used, and the incidence of complications is decreasing. Given the good results that can be achieved with standard neurosurgical resection, radiosurgery is the treatment of choice for small, poorly accessible arteriovenous malformations or patients in poor medical condition.

Radiosurgical ablation is also being used increasingly to treat benign tumors such as acoustic neurinoma and unresectable or recurrent skull base meningioma. By delivering a single large dose of radiation, stereotactic radiosurgery prevents tumor growth in greater than 95% of patients with acoustic neurinomas, and, in 40% of patients, tumor shrinkage occurs. Radiosurgery is associated with transient facial weakness or facial sensory disturbance in 30% of patients. Nevertheless, hearing can sometimes be preserved, especially with smaller lesions. Although radiosurgery prevents symptomatic and radiographic progression in nearly all cases of meningioma, the follow-up of such patients is only a few years. The proximity of the radiation-sensitive optic nerves or chiasm limits the aggressiveness of the radiosurgical treatment of recurrent or unresectable pituitary tumors. New radiosurgical instrumentation and computerized imaging techniques have renewed interest in treating these lesions by these methods. Although radiosurgery has also been used to treat several other types of benign tumors such as hemangioblastoma, craniopharyngioma, and neoplasms of the pineal gland, the benefits of therapy are largely anecdotal. Overall, radiosurgery can be helpful for managing many challenging small benign brain tumors.

Although radiosurgery has been used for only a brief time to treat malignant brain tumors, results have been encouraging. In preliminary studies, a stereotactic "boost" has been used to treat intrinsic malignant gliomas. Furthermore, several investigators have reported impressive local tumor control and minimal morbidity using radiosurgery to treat metastatic brain lesions. Given the relative ease of radiosurgical ablation, this treatment may supplant standard techniques of removing tumors. Clinical trials are in progress to investigate this hypothesis. Ultimately the most widespread use of radiosurgery may be for the management of malignant neoplasms.

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Corpus Callosotomy for Intractable Epilepsy in Children

THE SURGICAL TREATMENT OF medically intractable seizures is now a well-established and expanding aspect of the management of adults with epilepsy. In many cases, the focal epileptogenic area of the brain is first localized by scalp or intracranial electroencephalographic (EEG) recordings and then is excised by craniotomy. The most common operation for seizure in adults is the temporal lobectomy, since partial seizures originating there are relatively common and are frequently difficult to control with anticonvulsants.

Surgical therapy for medically intractable seizures is now being done on patients in the pediatric age range. This is due to several factors. There have been substantial improvements in seizure monitoring and implantable electrode technology. There is mounting evidence to suggest that surgical intervention must occur relatively early in life, before the educational and social deprivation that typically cripples persons with long-standing uncontrolled seizures.

In addition to the relatively rare partial epilepsies, a common epileptic syndrome in children is symptomatic generalized epilepsy. This syndrome may arise as a result of widespread, even bilateral, regions of epileptogenesis and is characterized by a bilateral onset of seizures as recorded by EEG. These attacks occur as atonic "drop attacks," tonic